Replace the paragraph on pages 4-5, lines 10-6, respectively, with the following:

a2

Assuming that ink expulsion mechanism 14 is a thermally actuated device such as a resistor, an ink drop is expelled by essentially boiling a drop of ink through nozzle 31. During formation and collapse of a boiling ink bubble, a series of acoustic pressure waves 26 (hereinafter referred to as "pressure waves") are produced. These waves propagate through the components of the print head, including primarily the substrate and ink well.

In the substrate (and conventional thin film layers formed thereon), both longitudinal and shear waves are produced. Longitudinal waves can be detected by an interdigitated piezoelectric pressure wave transducer 50 or the like which is described in more detail with reference to Figs. 3 and 4. In the ink well, longitudinal pressure waves are produced. These waves can be detected with a piezoelectric acoustic pressure wave transducer 40 which is described in more detail with reference to Fig. 2.

For purposes of the present discussion, the term "interdigitated transducer" will be used for the interdigitated piezoelectric pressure wave transducer and the term "acoustic transducer" will be used for the piezoelectric acoustic pressure wave transducer. While both an acoustic transducer and an interdigitated transducer are described as being provided on substrate 12, it should be recognized that they need not be provided together because either transducer is capable of sufficiently detecting pressure waves. The provision of both provides redundancy.

Replace the paragraph on pages 5-6, lines 18-9, respectively, with the following:

a3

Referring to Fig. 2, a side view of an acoustic transducer in accordance with the present invention is shown. Fig. 2

cont'd a3

illustrates the acoustic transducer of Fig. 1 in more detail. Fig. 2 illustrates substrate 12 on which the following layers are formed: an insulation layer 21, a conductive coupling layer 41, piezoelectric material 42, a first and a second signal conductive layer 44,45, a passivation layer 47 and a surface coat layer 48. In a preferred embodiment, these layers are made of the following or a like material: insulation layer 21 is silicon dioxide (SiO_2), conductive layer 41 is tantalum aluminum (TaAl), piezoelectric material 42 is aluminum nitride (AlN), first and second conductive layers or traces 44,45 are aluminum (Al), passivation layer 47 includes a first layer of silicon nitride (Si_3N_4) and a second layer of silicon carbide (SiC), and coating layer 48 is tantalum (Ta). It should be recognized that the arrangement and composition of these layers may be altered in a manner consistent with device fabrication techniques without deviating from the present invention. It should also be recognized that other piezoelectric material such as zinc oxide (ZnO) or PZT may be used and that other types of suitable pressure sensors may be used.

Replace the paragraph on page 6, lines 10-17, with the following:

a4

The first and second conductive layers 44,45 form conductors for reading a voltage generated by piezoelectric material 42 in response to an incident pressure wave. A pressure wave traveling through the ink well compresses the thin film stack, resulting in a mechanical strain in the thin film layers. In the piezoelectric layer, this strain produces a measurable electric charge across the two conductors.

Replace the paragraph on page 7, lines 3-21, with the following:

a5

Referring to Fig. 4, a plan view of an arrangement of acoustic transducers and interdigitated transducers in a print

contd a5

head in accordance with the present invention is shown. Fig. 4 illustrates substrate 12, a plurality of ink expulsion mechanisms 14, barrier layer 20, ink well 24, a plurality of acoustic transducers 40 and a plurality of interdigitated transducers 50. Orifice plate 30 would be placed over the arrangement of Fig. 4 with nozzles aligned with the ink expulsion mechanisms 14. It should be recognized that the transducer arrangement disclosed in Fig. 4 is representative and provided for pedagogical purposes. The ink expulsion mechanisms, ink well and the size, number and arrangement of transducers may be modified from that of Fig. 4 without departing from the present invention. Furthermore, it should be recognized that although the interdigitated transducers are shown in the ink well, since they detect pressure waves in the substrate they may be placed anywhere on the substrate including under the barrier layer."

In the Claims:

a6

1 (amended). A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism provided on said substrate;

an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well; and

a first pressure sensor that is formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism.

a7

4 (amended). The apparatus of claim 1, further comprising:

a barrier layer formed on said substrate;

a cover plate having a nozzle therein formed on said barrier layer and positioned such that said nozzle is aligned with said ink expulsion mechanism, said substrate, barrier and cover plate defining said ink well; and